

USSN 09/981,431

Response

Amendments to the Claims

Please amend the claims as follows:

1. **(currently amended)** A cleaning composition for a semiconductor substrate, consisting essentially of: effective amounts of a cleaning agent and at least one antimicrobial agent, and a solvent, the composition having a pH of about 4.5-6.5.
2. **(original)** The cleaning composition of Claim 1, wherein the cleaning agent comprises a hydroxycarboxylic acid, a hydroxycarboxylic acid salt, or a mixture thereof.
3. **(original)** The cleaning composition of Claim 2, wherein the cleaning agent comprises a hydroxycarboxylic acid selected from the group consisting of citric acid, malic acid, tartaric acid, glycolic acid, lactic acid, and tartronic acid.
4. **(original)** The cleaning composition of Claim 2, wherein the cleaning agent comprises a hydroxycarboxylic acid salt selected from the group consisting of a citric acid salt, malic acid salt, tartaric acid salt, glycolic acid salt, lactic acid salt, and tartronic acid salt.
5. **(original)** The cleaning composition of Claim 2, wherein the cleaning agent is selected from the group consisting of citric acid and citric acid salts.
6. **(original)** The cleaning composition of Claim 5, wherein the cleaning agent comprises a citric acid salt selected from the group consisting of ammonium citrate, and a tetraalkylammonium citrate.
7. **(original)** The cleaning composition of Claim 1, wherein the antimicrobial agent is selected from the group consisting of benzoic acid, sorbic acid, and salts thereof.

USSN 09/981,431

Response

8. (withdrawn) The cleaning composition of Claim 7, wherein the antimicrobial agent comprises a benzoic acid salt selected from the group consisting of ammonium benzoate, potassium benzoate, and tetraalkylammonium benzoate.
9. (original) The cleaning composition of Claim 7, wherein the antimicrobial agent comprises a sorbic acid salt selected from the group consisting of ammonium sorbate, potassium sorbate, and tetraalkylammonium sorbate.
10. (original) The cleaning composition of Claim 7, wherein the antimicrobial agent is selected from the group consisting of benzoic acid, sorbic acid, ammonium benzoate, potassium benzoate, tetraalkylammonium benzoate, potassium sorbate, ammonium sorbate, and tetraalkylammonium sorbate.
11. (withdrawn) The cleaning composition of Claim 1, wherein the antimicrobial agent comprises a sulfite.
12. (withdrawn) The cleaning composition of Claim 11, wherein the antimicrobial agent is selected from the group consisting of sulfur dioxide, potassium bisulfite, and potassium metabisulfite.
13. (withdrawn) The cleaning composition of Claim 1, wherein the antimicrobial agent comprises an alkyl parahydroxybenzoate.
14. (withdrawn) The cleaning composition of Claim 13, wherein the antimicrobial agent is selected from the group consisting of methylparahydroxybenzoate, ethylparahydroxybenzoate, propylparahydroxybenzoate, and n-heptylparahydroxybenzoate.
15. (currently amended) The cleaning composition Claim 1, having a pH of about 5-6 ~~4-5 to about 6-5~~.

MKE/1114324.1

3 of 22

USSN 09/981,431

Response

16. (original) The cleaning composition of Claim 15, further comprising a buffering agent.
17. (original) The cleaning composition of Claim 16, wherein the buffering agent is selected from the group consisting of ammonium hydroxide, and tetraalkylammonium hydroxide.
18. (currently amended) A cleaning composition for a semiconductor substrate, consisting essentially of: a cleaning agent selected from the group consisting of hydroxycarboxylic acids and salts thereof, at least one antimicrobial agent selected from the group consisting of benzoic acid, sorbic acid, and salts thereof, and solvent, the composition having a pH of about 4 to about 6.5.
19. (original) The cleaning composition of Claim 18, wherein the cleaning agent is selected from the group consisting of citric acid, malic acid, tartaric acid, glycolic acid, lactic acid, tartronic acid, and salts thereof.
20. (original) The cleaning composition of Claim 19, wherein the cleaning agent is selected from the group consisting of citric acid, ammonium citrate, and tetraalkylammonium citrate.
21. (withdrawn) The cleaning composition of Claim 18, wherein the antibacterial agent comprises a benzoic acid salt selected from the group consisting of ammonium benzoate, potassium benzoate, and tetraalkylammonium benzoate.
22. (original) The cleaning composition of Claim 18, wherein the antibacterial agent comprises a sorbic acid salt selected from the group consisting of potassium sorbate, ammonium sorbate, and tetraalkylammonium sorbate.
23. (original) The cleaning composition of Claim 18, wherein the solvent is selected from the group consisting of water, and an organic solvent.

USSN 09/981,431

Response

24. (original) The cleaning composition of Claim 23, wherein the solvent comprises deionized water.
25. (withdrawn) The cleaning composition of Claim 23, wherein the solvent comprises an organic solvent selected from the group consisting of methanol, ethanol, n-propanol, iso-propanol, n-butanol, t-butanol, sec-butanol, ethylene glycol, and propylene glycol.
26. (canceled)
27. (currently amended) The cleaning composition of Claim 18, wherein the cleaning composition further comprises a pH buffering agent to adjust the pH to about [4-] 4.5 to about 6.
28. (currently amended) A cleaning composition for a semiconductor substrate, consisting essentially of a cleaning agent selected from the group consisting of citric acid and a citric acid salt; and an antimicrobial agent selected from the group consisting of benzoic acid, sorbic acid, and salts thereof; and solvent the composition having a pH of about 4.5-6.5.
29. (withdrawn) The cleaning composition of Claim 28, wherein the antimicrobial agent comprises a benzoic acid salt selected from the group consisting of ammonium benzoate, potassium benzoate, and tetraalkylammonium benzoate.
30. (original) The cleaning composition of Claim 28, wherein the antimicrobial agent comprises a sorbic acid salt selected from the group consisting of ammonium sorbate, potassium sorbate, tetraalkylammonium sorbate.
31. (currently amended) A cleaning composition for a semiconductor substrate, consisting essentially of: a cleaning agent capable of dispersing alumina or silica slurry particles and supporting microbial growth, an antimicrobial agent present in an amount effective to inhibit bacterial growth in the cleaning composition and on the surface of the substrate when the composition is applied thereto, effective amounts of one or more of a surfactant, buffering agent,

MKE/1114324.1

5 of 22

USSN 09/981,431

Response

corrosion inhibitor, chelating agent, oxidizing agent, and antioxidant, and solvent, the composition having a pH of about 4.5-6.5.

32. (original) The cleaning composition of Claim 31, wherein the cleaning agent comprises a hydroxycarboxylic acid selected from the group consisting of a hydroxycarboxylic acid, and hydroxycarboxylic acid salts.

33. (original) The cleaning composition of Claim 32, wherein the cleaning agent is selected from the group consisting of citric acid, malic acid, tartaric acid, glycolic acid, lactic acid, and tartronic acid.

34. (original) The cleaning composition of Claim 32, wherein the cleaning agent comprises citric acid or a salt thereof.

35. (original) The cleaning composition of Claim 34, wherein the cleaning agent comprises a citric acid salt selected from the group consisting of ammonium citrate, and tetraalkylammonium citrate.

36. (original) The cleaning composition of Claim 35, wherein the cleaning agent comprises tetramethylammonium citrate.

37. (original) The cleaning composition of Claim 31, wherein the antimicrobial agent is selected from the group consisting of benzoic acid, sorbic acid, ammonium benzoate, potassium benzoate, tetraalkylammonium benzoate, ammonium sorbate, potassium sorbate, and tetraalkylammonium sorbate.

38. (withdrawn) The cleaning composition of Claim 31, wherein the antimicrobial agent comprises a sulfite.

USSN 09/981,431

Response

39. (withdrawn) The cleaning composition of Claim 38, wherein the antimicrobial agent is selected from the group consisting of sulfur dioxide, potassium bisulfite, and potassium metabisulfite.
40. (withdrawn) The cleaning composition of Claim 31, wherein the antimicrobial agent comprises an alkyl parahydroxybenzoate.
41. (withdrawn) The cleaning composition of Claim 40, wherein the antimicrobial agent is selected from the group consisting of methylparahydroxybenzoate, ethylparahydroxybenzoate, propylparahydroxybenzoate, and n-heptylparahydroxybenzoate.
42. (currently amended) A cleaning composition for a semiconductor surface, comprising an aqueous composition consisting essentially of:
- about 0.02 to about 1.5 % by weight cleaning agent;
 - about 0.005 to about 0.3 % by weight antimicrobial agent;
 - an effective amount of at least one of a surfactant, buffering agent, corrosion inhibitor, chelating agent, oxidizing agent, and antioxidant; and
 - the balance solvent;
- the composition having a pH of about 4.5-6.5, and the % by weight based on the total weight of the cleaning composition.
43. (original) The cleaning composition of Claim 42, wherein the cleaning agent is selected from the group consisting of hydroxycarboxylic acids and salts thereof.
44. (original) The cleaning composition of Claim 43, wherein the cleaning agent is selected from the group consisting of citric acid, malic acid, tartaric acid, lactic acid, glycolic acid, tartronic acid, and salts thereof.
45. (original) The cleaning composition of Claim 43, wherein the cleaning agent is selected from the group consisting of citric acid, ammonium citrate, and tetraalkylammonium citrate.

MKE/1114324.1

7 of 22

USSN 09/981,431

Response

46. (original) The cleaning composition of Claim 42, wherein the antimicrobial agent is selected from the group consisting of benzoic acid, sorbic acid, and salts thereof.
47. (withdrawn) The cleaning composition of Claim 42, wherein the antimicrobial agent is selected from the group consisting of benzoic acid, sorbic acid, ammonium benzoate, potassium benzoate, tetraalkylammonium benzoate, ammonium sorbate, potassium sorbate, and tetraalkylammonium sorbate.
48. (withdrawn) The cleaning composition of Claim 42, wherein the antimicrobial agent is selected from the group consisting of a sulfite, and an alkyl parahydroxybenzoate.
49. (currently amended) The cleaning composition of Claim 42, wherein the pH of the composition is about 5-6 ~~4.5 to about 6.5~~.
50. (previously presented) The cleaning composition of Claim 42, wherein the amount of the cleaning agent is about 0.05 to about 0.5 % by weight, and the amount of the antimicrobial agent is about 0.01 to about 0.2 % by weight.
51. (currently amended) A cleaning composition for a semiconductor surface, comprising an aqueous mixture consisting essentially of:
- about 0.02 to about 1.5 % by weight cleaning agent selected from the group consisting of hydroxycarboxylic acids and salts thereof;
 - about 0.005 to about 0.3 % by weight of a first antimicrobial agent selected from the group consisting of benzoic acid and salts thereof;
 - about 0.005 to about 0.3 % by weight of a second antimicrobial agent selected from the group consisting of sorbic acid and salts thereof; and
 - the balance solvent;
- the composition having a pH of about 4.5-6.5, and the % by weight based on the total weight of the cleaning composition.

MKE/1114324.1

8 of 22

USSN 09/981,431

Response

52. **(currently amended)** A cleaning composition for a semiconductor surface, consisting essentially of:

about 0.02 to about 1.5 % by weight citric acid, citric acid salt, or a mixture thereof;

about 0.005 to about 0.3 % by weight benzoic acid, benzoic salt, or a mixture thereof;

about 0.005 to about 0.3 % by weight sorbic acid, sorbic acid salt, or a mixture thereof; and

the balance solvent;

the composition having a pH of about 4.5-6.5, and the % by weight based on the total weight of the cleaning composition.

53. **(original)** The cleaning composition of Claim 52, wherein the solvent comprises deionized water.

54. **(currently amended)** A cleaning composition for a semiconductor surface, consisting essentially of:

about 0.02 to about 1.5 % by weight of a cleaning agent selected from the group consisting of citric acid, ammonium citrate, and tetraalkylammonium citrate;

about 0.005 to about 0.3 % by weight of a first antimicrobial agent selected from the group consisting of benzoic acid, potassium benzoate, ammonium benzoate, and tetraalkylammonium benzoate;

about 0.005 to about 0.3 % by weight of a second microbial agent selected from the group consisting of sorbic acid, potassium sorbate, ammonium sorbate, and tetraalkylammonium sorbate; and

the balance solvent;

the composition having a pH of about 4.5-6.5, and the % by weight based on the total weight of the cleaning composition.

55. **(currently amended)** A cleaning composition for a semiconductor surface, consisting essentially of: an acidic aqueous solution comprising a cleaning agent selected from the group consisting of citric acid and citric acid salts; one or more antimicrobial agents selected from the

USSN 09/981,431

Response

group consisting of a benzoic acid, benzoic acid salts, sorbic acid, and sorbic acid salts; and water, the composition having a pH of about 4.5-6.5.

56. (original) The cleaning composition of Claim 55, wherein the cleaning agent is a selected from the group consisting of citric acid, ammonium citrate, and tetraalkylammonium citrate.

57. (original) The cleaning composition of Claim 55, wherein the antimicrobial agent is selected from the group consisting of benzoic acid, sorbic acid, potassium benzoate, ammonium benzoate, tetraalkylammonium benzoate, potassium sorbate, ammonium sorbate, and tetraalkylammonium sorbate.

58. (original) The cleaning composition of Claim 55, comprising ammonium citrate, potassium benzoate, and potassium sorbate.

59. (original) The cleaning composition of Claim 55, comprising ammonium citrate, ammonium benzoate, and potassium sorbate.

60. (currently amended) A cleaning composition for a semiconductor surface comprising an acidic aqueous solution consisting essentially of: about 0.02 to about 1.5 % by weight citric acid, citric acid salt, or a mixture thereof, about 0.005 to about 0.3 % by weight antimicrobial agent, and water based on the total weight of the cleaning composition; the antimicrobial agent selected from the group consisting of benzoic acid, sorbic acid, potassium benzoate, ammonium benzoate, tetraalkylammonium benzoate, potassium sorbate, ammonium sorbate, tetraalkylammonium sorbate, methylparahydroxybenzoate, ethylparahydroxybenzoate, propylparahydroxybenzoate, and n-heptylparahydroxybenzoate, sulfur dioxide, potassium bisulfite, and potassium metabisulfite, the composition having a pH of about 4.5-6.5.

61. (currently amended) The cleaning composition of Claim 60, wherein the composition has a pH of about ~~5-6~~ 4.5 to about 6.5.

MKE/1114324.1

10 of 22

USSN 09/981,431

Response

62. (currently amended) A cleaning composition for cleaning a planarized or polished surface of a semiconductor wafer, the composition consisting essentially of: a mixture of a cleaning agent, an antimicrobial agent, and solvent in amounts relative to one another to formulate an effective cleaning composition such that microbial growth within the cleaning composition is inhibited, and when the composition is in contact with both a metal conductive structure and a dielectric layer, residual particles are removed therefrom with no significant defects to the conductive structure or the dielectric layer, and microbial deposition on the planarized or polished surface is inhibited, the composition having a pH of about 4.5-6.5.

63. (previously presented) The cleaning composition of Claim 62, wherein the amount of the cleaning agent is about 0.02 % to about 1.5 %, the cleaning agent comprising a hydroxycarboxylic acid, a hydroxycarboxylic acid salt, or a mixture thereof.

64. (original) The cleaning composition of Claim 63, wherein the cleaning agent comprises citric acid, citric acid salt, or a mixture thereof.

65. (previously presented) The cleaning composition of Claim 62, wherein the amount of the antimicrobial agent is about 0.005 % to about 0.3 %.

66. (original) The cleaning composition of Claim 62, wherein the antimicrobial agent is selected from the group consisting of benzoic acid, sorbic acid, potassium benzoate, ammonium benzoate, tetraalkylammonium benzoate, potassium sorbate, ammonium sorbate, tetraalkylammonium sorbate, benzoic acid, sorbic acid, ammonium benzoate, potassium benzoate, tetraalkylammonium benzoate, ammonium sorbate, potassium sorbate, and tetraalkylammonium sorbate.

67. (withdrawn) The cleaning composition of Claim 62, wherein the antimicrobial agent is selected from the group consisting of a sulfite, and an alkyl parahydroxybenzoate.

USSN 09/981,431

Response

68. (withdrawn) The cleaning composition of Claim 67, wherein the antimicrobial agent is selected from the group consisting of sulfur dioxide, potassium bisulfite, and potassium metabisulfite.

69. (withdrawn) The cleaning composition of Claim 67, wherein the antimicrobial agent is selected from the group consisting of methylparahydroxybenzoate, ethylparahydroxybenzoate, propylparahydroxybenzoate, and n-heptylparahydroxybenzoate.

70. (original) The cleaning composition of Claim 62, wherein the solvent comprises water, an organic solvent, or a mixture thereof.

71. (original) The cleaning composition of Claim 62, wherein the solvent comprises deionized water.

72. (canceled)

73. (original) The cleaning composition of Claim 62, having a pH of ~~between~~ about 5 and to about 6.

74. (withdrawn) The cleaning composition of Claim 62, wherein the metal conductive structure comprises a metal selected from the group consisting of copper, aluminum, silver, tungsten, platinum, titanium, and tantalum.

75. (withdrawn) The cleaning composition of Claim 62, wherein the dielectric layer comprises a dielectric material selected from the group consisting of silicon dioxide, phosphosilicate glass, borosilicate glass, borophosphosilicate glass, carbon-doped silica, and porous silica.

76. (canceled)

MKE/1114324.1

12 of 22

USSN 09/981,431

Response

77. (currently amended) The cleaning composition of Claim ~~76~~ 62, wherein the residual metal particles are selected from the group consisting of copper, aluminum, platinum, titanium, silver, tungsten, and tantalum particles.

78. (withdrawn) The cleaning composition of Claim 62, wherein the residual particles comprise abrasive slurry particles.

79. (withdrawn) The cleaning composition of Claim 78, wherein the abrasive slurry particles are selected from the group consisting of aluminum oxide, titanium dioxide, silicon dioxide, cerium dioxide, and mixtures thereof.

80-138. (canceled)

139. (currently amended) A cleaning composition for a semiconductor substrate, consisting essentially of: effective amounts of a cleaning agent and at least one antimicrobial agent, effective amounts of at least one of a surfactant, buffering agent, corrosion inhibitor, chelating agent, oxidizing agent, and antioxidant; and a solvent, the composition having a pH of about 4.5-6.5.

140. (currently amended) A cleaning composition for a semiconductor substrate, consisting essentially of: effective amounts of a cleaning agent and at least one antimicrobial agent, effective amounts of at least one of a surfactant, buffering agent, corrosion inhibitor, chelating agent, oxidizing agent, and antioxidant; and water, the composition having a pH of about 4.5-6.5.

141. (currently amended) A cleaning composition for a semiconductor substrate, consisting essentially of: effective amounts of a cleaning agent, antimicrobial agent, and solvent to formulate an effective cleaning composition for removing residual particles from the substrate and inhibiting microbial deposition onto the substrate, the composition having a pH of about 4.5-6.5.

MKE/1114324.1

13 of 22

USSN 09/981,431

Response

142. **(currently amended)** A cleaning composition for a semiconductor substrate, consisting essentially of: effective amounts of a cleaning agent, antimicrobial agent, and solvent to formulate an effective cleaning composition for removal of residual particles from the substrate, the residual particles comprising at least one of residual metal particles, abrasive particles, and dielectric particles, the composition having a pH of about 4.5-6.5.

143. **(currently amended)** A cleaning composition for a semiconductor substrate consisting essentially of: effective amounts of a cleaning agent, antimicrobial agent, and solvent to formulate an effective cleaning composition for removal of residual particles from the substrate, the residual particles comprising at least one of metal particles and abrasive particles, the composition having a pH of about 4.5-6.5.

144. **(previously presented)** The cleaning composition of Claim 143, wherein the residual particles comprise residual metal particles selected from the group consisting of copper particles, aluminum particles, platinum particles, titanium particles, and tantalum particles.

145. **(previously presented)** The cleaning composition of Claim 143, wherein the residual particles comprise abrasive particles selected from the group consisting of aluminum oxide particles, titanium dioxide particles, silicon dioxide particles, and cerium dioxide particles.

146. **(currently amended)** A cleaning composition for a semiconductor substrate, consisting essentially of: effective amounts of a cleaning agent, antimicrobial agent, and about 90-99% by weight solvent to formulate an effective cleaning composition for removing residual particles from the substrate and inhibiting microbial deposition onto the substrate, the composition having a pH of about 4.5-6.5.

147. **(currently amended)** A cleaning composition for a semiconductor substrate, consisting essentially of: effective amounts of a cleaning agent, antimicrobial agent, buffering agent, and solvent to formulate an effective cleaning composition for removing residual particles from the

USSN 09/981,431

Response

substrate and inhibiting microbial deposition onto the substrate, the composition having a pH of about 4.5-6.5.

148. **(currently amended)** A cleaning composition for a semiconductor substrate, consisting essentially of: effective amounts of a cleaning agent and at least one antimicrobial agent; effective amounts of at least one of a surfactant, buffering agent, corrosion inhibitor, chelating agent, oxidizing agent, and antioxidant; and solvent, to formulate an effective cleaning composition for removal of residual particles from the substrate and inhibiting microbial deposition onto the substrate, the composition having a pH of about 4.5-6.5.